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FAMILY LYCEUM.

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THE ANCIENTS.

From Platt's Universal Biography.

PLATO.

PLATO, an illustrious philosopher of antiquity, was by descent an Athenian, though the place of his birth was the island of Ægina. His descent by his father was from Codrus, the last king of Athens, and by his mother, from Solon, the celebrated legislator. The time of his birth is placed at the beginning of the eighty-eighth Olympiad; but Dr. Enfield thinks it may be more accurately fixed in the third year of the eighty-seventh Olympiad, or B. C. 430. He gave early indications of an extensive and original genius, and had an education suitable to his high rank, being instructed in the rudiments of letters by the grammarian Dionysius, and trained in athletic exercises by Ariston of Argos. He applied with great diligence to the arts of painting and poetry; and wrote an epic poem, which, upon comparing it with those of Homer, he burnt. He next wrote a dramatic piece, which was to have been acted, but happening to attend upon a discourse of Socrates, he was so captivated by his eloquence, that he reclaimed his tragedy, renounced the muses, burnt all his poems, and applied himself wholly to the study of wisdom. It is said that Plato's first masters in philosophy were Eratylus and Hermogenes, who taught the system of Heraclites and Parmenides; but when he was twenty years old, he attached himself wholly to Socrates, with whom he remained eight years as a scholar. During this period, he frequently displeased his companions, and sometimes even his master, by grafting upon the Socratic system opinions which were taken from some other stock. Plato, however, retained the warmest attachment to his master. When that great and good man was summoned before the senate, his illustrious scholar undertook to plead his cause, and began a speech in his defence; but the partial judges would not permit him to proceed. After the condemnation he presented his master with money sufficient to redeem his life; which, however, Socrates refused to accept. During his imprisonment, Plato attended him, and was present at a conversation which he held with his friends concerning the immortality of the soul; the substance of which he afterwards committed to writing in the beautiful dialogue entitled Phædo. The philosophers at Athens were so alarmed at the death of Socrates, that most of them fled from the city. Plato, whose grief upon this occasion is said by Plutarch to have been excessive, retired to Megara, where he was kindly entertained by Euclid, who had been one of the first scholars of Socrates, till the storm was over. Afterwards he travelled in pursuit of knowledge; and from Megara he went to Italy, where he conferred with Eurytus, Philolaus, and Archytas, the most celebrated of the followers of Pythagoras, whose doctrine was then become famous in Greece; and from these the Pythagoreans have affirmed that he had all his natural philosophy. He next went to Cyrene, where he learned geometry of Theodorus the mathematician. Thence he passed into Egypt, to acquire theology, to study more nicely the proportions of geometry, and to instruct himself in astronomical observations; and having taken a full survey of all the country, he settled for some time in the province of Sais, learning of the wise men there what they held concerning the universe, whether it had a beginning, whether it moved wholly or in part, &c.; and Pausanias affirms, that he learned from these the immortality and transmigration of souls. He next travelled into Persia, to consult the Magi about the religion of that country. He then returned to Italy, to the Pythagorean school at Tarentum, where he endeavored to improve his own system, by incorporating with it the doctrine of Pythagoras, as it was then taught by Archytas, Timæus, and others. And afterwards, when he visited Sicily, he retained such an attachment to the Italic school, that, through the bounty of Dionysius, he purchased at a vast price several books which contained the doctrine of Pythagoras, from Philolaus, one of his followers. Returning home richly stored with knowledge of various kinds, Plato settled at Athens, and formed a new school for the instruction of youth in philosophy in the academy. This new school soon became famous, and its master was ranked among the most eminent philosophers. People of the first distinction in every department frequented the academy.—Even females dressed in men's clothes often attended his lectures. Among the illustrious names which appeared in the catalogue of his followers, are, Dion, the Syracusan prince, and the orators, Hyperides, Lycurgus, Demosthenes, and Isocrates. The distinguished reputation of Plato brought upon him the envy of his former companions in the school of Socrates, and they loaded him with detraction and obloquy. From this spirit, Xenophon and he, though they relate the discourses of their common master, avoid mentioning one another. Diogenes, the cynic, ridiculed Plato's doctrine of ideas. In the midst of these private censures, however, the public fame of Plato daily increased; and several states, among which were the Arcadians and Thebans, sent ambassadors with earnest requests that he would come over, not only to instruct the young men in philosophy, but also to prescribe them laws of government. The Cyrenians, Syracusans, Cretans, and Eleans, sent also to him; he did not go to any of them, but gave laws and rules of government to all. He lived single, yet soberly and chastely. He was a man of great virtues, and exceedingly affable; of which we need no greater proof, than his civil manner of conversing with the philosophers of his own times, when pride and envy were at their height. Diogenes, piqued at the politeness and fine taste of Plato, took every opportunity of snarling at him. He dined one day at Plato's table with other company, and, trampling upon the tapestry with his dirty feet, said, 'I trample upon the pride of Plato;' to which Plato wisely reparteed, 'With greater pride.' The fame of Plato drew disciples to him from all parts, among whom were Speusippus, an Athenian, his sister's son, whom he appointed his successor in the academy, and the great Aristotle. The admiration of this illustrious man was not confined to a few philosophers. He was in high esteem with several princes, particularly Archelaus, king of Macedon, and Dionysius, tyrant of Sicily. At three different periods he visited the court of this latter prince, and made several bold but unsuccessful attempts to subdue his haughty spirit. The professed object, says Dr. Enfield, (in his Hist. of Phi.) of Plato's first visit to Sicily, which happened in the fortieth year of his age, during the reign of the Elder Dionysius, the son of Hermocrates, was to take a survey of the island, and particularly of Mount Ætna.—Whilst he resided at Syracuse, he was employed in the instruction of Dion, the King's brother-in-law, who possessed excellent abilities, though hitherto restrained by a tyrannical government, and relaxed by the luxuries of a licentious court. Disgusted by the debaucheries of the Syracusans, Plato endeavored to rescue his pupil from the general depravity. Nor did Dion disappoint his hopes. No sooner had he received a taste of that philosophy which leads to virtue, than he was fired with an ardent love of wisdom. Hoping that philosophy might produce the same effect upon Dionysius, he procured an interview between Plato and the tyrant. During the conference, whilst Plato discoursed on the happiness of virtue, and the miseries attending injustice and oppression, Dionysius took offence, dismissed him with displeasure, and even formed a design against his life.—It was not without difficulty that Plato escaped. A vessel which had brought over Polis, a delegate from Sparta, was fortunately then returning to Greece. Dion engaged to land Plato safely in his native country; but Dionysius discovered the design, and made Polis promise that he would either put him to death, or sell him as a slave. Polis accordingly sold him in his native island of Ægina. Anicerris, a Cyrenaic philosopher, discovered the stranger, and purchased his freedom for thirty minæ, (£84 10s. sterling), and sent him home to Athens. Repayment being afterwards offered to Anicerris by Plato's relations, he refused the money, saying, with that generous spirit which true philosophy inspires, that he saw no reason why the relations of Plato should engross to themselves the honor of serving him. After a short time, Dionysius repented of his unjust resentment, and wrote to Plato, requesting him to repair his credit by returning to Syracuse; to which Plato gave this high-spirited answer, that philosophy would not allow him leisure to think of Dionysius. He was, however, prevailed upon by Dion to return to Syracuse, and take upon him the education of Dionysius the younger, the heir apparent. He was received, by Dionysius I., with every possible respect; but after seeing his friend banished, and being himself kept as a kind of prisoner at large in the palace, he was by the tyrant sent back into his own country, with a promise that both he and Dion should be recalled at the end of the war in which the Sicilians were then engaged.—This promise was not fulfilled. The tyrant wished for the return of Plato; but could not resolve to recall Dion. At last, however, having probably promised that the philosopher should meet his friend at the court of Syracuse, he prevailed upon Plato to visit that capital a third time. When he arrived, the king met him in a magnificent chariot, and conducted him to his palace. The Sicilians too rejoiced in his return; for they hoped that the wisdom of Plato would at length triumph over the tyrannical spirit of the prince. Dionysius seemed wholly divested of his former resentments, listened with apparent pleasure to the philosopher's doctrine, and among other expressions of regard, presented him with eighty talents of gold.—In the midst of a numerous train of philosophers, Plato now possessed the chief influence and authority in the court of Syracuse. While Arisippus was enjoying himself in splendid luxury, while Diogenes was freely indulging his acrimonious humor, and while Æschines was gratifying his thirst after riches, Plato supported the credit of philosophy with an air of dignity which his friends regarded as an indication of superior wisdom, but which his enemies imputed to pride.—After all, Plato could not prevail upon Dionysius to alter his system of policy, or to recall Dion from exile. At length Plato requested permission to return to Greece, which was at last granted him, and he was sent home loaded with rich presents. On his way to Athens, passing through Elis during the celebration of the Olympic games, he was present at this assembly of the Greeks, and engaged universal attention. From this narrative, it appears, that if Plato visited the courts of princes, it was chiefly from the hope of seeing his ideal plan of a perfect republic realized. Plato now devoted himself to science, and spent the last years of a long life in the instruction of youth. Having enjoyed the advantage of an athletic constitution, and lived all his days temperately, he arrived at the seventy-ninth or eighty-first year of his age, and died in the first year of the one hundred and eighth Olympiad. He passed his whole life in a state of celibacy, and therefore left no natural heirs, but transferred his effects, by will, to his friend Adiamantus. The grove and garden, which had been the scene of his philosophical labors, at last afforded him a sepulchre. Statues and altars were erected to his memory; the day of his birth long continued to be celebrated as a festival by his followers; and his portrait is to this day preserved in gems; but the most lasting monuments of his genius are his writings, which have been transmitted without material injury to the present times. The character of this philosopher has always been high. He had a comprehensive understanding, a vast fund of wit and good taste, great sweetness of temper, all cultivated and refined by education and travel, so that he was honored by his countrymen, esteemed by strangers, and adored by his scholars. The ancients thought more highly of Plato than of all their philosophers; they always called him the Divine Plato; and they resolved that his descent should be more than human, for Apuleius mentions a common report, 'that his mother Perictione, who was a very beautiful woman, was impregnated by Apollo in the shape of a spectre.' Plutarch, Suidas, and others, affirm this to have been the common report at Athens. When he was an infant, his father Ariston went to Hymettus, with his wife and child, to sacrifice to the Muses; and while they were busied in the divine rites, a swarm of bees came and distilled their honey upon his lips. This, says Tully, was considered as a presage of his future eloquence. The Greeks loved fables; these show, however, what high respect was paid to the memory of Plato.—Tully adored him; tells how he was justly called, by Panætius, the divine, the most wise, the most sacred, the Homer of philosophers, entitled him to Athens, Deus ille noster; thought, that if Jupiter had spoken Greek, he would have spoken in Plato's language, and made him so implicitly his guide in wisdom and philosophy, as to declare, that he had rather err with Plato than be right with any one else. But, panegyric aside, Plato was certainly a very wonderful man, of an imagination amazingly fertile, and of a most copious eloquence. Yet the heat of fancy prevailing in his composition over his judgment, he was too apt to soar beyond the limits of earthly things, to range in the imaginary regions of general and abstracted ideas; and therefore though there is always a greatness and sublimity in his manner, he did not philosophize so much according to truth and nature as Aristotle, though Cicero gives him the preference.—The writings of Plato are all in the form of dialogue; where he seems to deliver nothing from himself, but every thing as the sentiments and opinions of others, of Socrates chiefly, of Timæus, &c. He does not mention himself any where, except once in his Phædo, and another time in his apology for Socrates. His style, as Aristotle observed, is between prose and verse, on which account some have not scrupled to rank him with the poets. A better reason may be assigned for this; his matter is oftentimes the offspring of imagination, instead of truths deduced from nature.

EUCLID.

EUCLID, the celebrated mathematician, according to the account of Pappus and Proclus, was born at Alexandria, in Egypt, where he flourished, and taught mathematics with great applause, under the reign of Ptolemy Lagus, about B. C. 280. And here, from his time, till the conquest of Alexandria by the Saracens, all the eminent mathematicians were either born or studied; and it is to Euclid and his scholars we are indebted for Eratosthenes, Archimedes, Apollonius, Ptolemy, Theon, &c. &c. He reduced into regularity and order all the fundamental principles of pure mathematics, which had been delivered down by Thales, Pythagoras, Eudoxus, and other mathematicians before him, and added many others of his own discovering; on which account, it is said he was the first who reduced arithmetic and geometry into the form of a science. He likewise applied himself to the study of mixed mathematics, particularly to astronomy and optics.

His works, as we learn from Pappus and Proclus, are, the Elements, Data, Introduction to Harmony, Phenomena, Optics, Catoprics, Treatises on the Division of Superficies, Porisms, Loci and Superficies, Fallacies, and four books of Comics.

The most celebrated of these is the first work, 'The Elements of Geometry'; of which there have been numberless editions, in all languages; and a fine edition of all his works now extant was printed in 1703, by David Gregory, Savilian Professor of Astronomy at Oxford.

The 'Elements,' as commonly published, consist of fifteen books, of which the two last, it is suspected, are not Euclid's, but a comment of Hypsicles of Alexandria, who lived two hundred years after Euclid. They are divided into three parts; the first four books treat of planes only; the fifth, of the proportions of magnitudes in general; the sixth, of the proportion of plane figures; the seventh, eighth, and ninth, give us the fundamental properties of numbers; the tenth contains the theory of commensurable and incommensurable lines and spaces; the eleventh, twelfth, thirteenth, fourteenth, and fifteenth, treat of the doctrine of solids.

There is no doubt, that before Euclid's time, Elements of Geometry were compiled by Hippocrates of Chius, Eudoxus, Leon, and many others, mentioned by Proclus, in the beginning of his second book; for he affirms, that Euclid new ordered many things in the Elements of Eudoxus, completed many things in those of Theatetus, and, besides, strengthened such propositions as before were too slightly, or but superficially established, with the most firm and convincing demonstrations.

History is silent as to the time of Euclid's death, or his age. He is represented as a person of a courteous and agreeable behaviour, and in great esteem and familiarity with king Ptolemy, who once asking him whether there was any shorter way of coming at geometry than by his Elements, Euclid, as Proclus testifies, made answer, that there was no royal way, or path, to geometry.

MAN.

From the Young Man's Book of Knowledge.

HIS INTELLECT.

Thus may the curiosity of man be gratified by surveying the productions of nature; and thus the farther he extends his researches, the more reason will he find to admire the general economy of created beings.—Whatever objects his eyes behold, whether small or great, he will see design and order impressed upon them, in the most conspicuous character. The stars scattered over the blue vault of heaven, and so numerous as to baffle calculation, whether they shine only to afford us light, or are the suns of other systems, and thus proclaim the extent of Almighty power, cannot fail to strike us with astonishment. The blazing *comets*, which were the dire prognostics, in the opinion of our ancestors, of the fall of kings, and the subversion of empires, we are taught by the improvements of philosophy to contemplate with admiration, devoid of terror; and to consider as the abodes of creatures endowed with various powers and faculties. The *earth* performing her annual and diurnal circuit around the centre of the system, so as to produce a regular change of seasons, and a succession of light and darkness: the *ocean* giving to mankind the constant advantages of its tides; and although frequently tempestuous, and sometimes threatening to mix its waves with the clouds, and to overflow the earth, yet obeying the invariable law of its flux and reflux, and never advancing beyond its prescribed bounds:—the *air*, which, from its partial pressure, would crush us to the ground, but by the elasticity of its internal resistance forming an exact counterbalance, clearly demonstrate the power, the wisdom, and the benignity of an omnipotent Creator. Time and space, substance and heat, are the vast materials of nature; the wide universe is the sphere in which they act; and life, activity, and happiness, constitute the end of their operations. The whole race of *animals* preserved to the present time in the same flourishing state in which they were at first created; the impulse of instinct directing them to wholesome food, to commodious habitations, and to the propagation of their kind; the structure of their frames, suitable to their immediate use; the several tribes of creatures subordinate to each other, conducive in various respects to the good of man; and the abundant provision made for their subsistence, are all evident and incontestible proofs of divine skill, contrivance, and power.

The human race, and all other beings, are formed with such exquisite ingenuity, that man is wholly unable to imitate the most simple fibre, vein, or nerve, much less to construct a hand, or any other organ of contrivance or execution. All living creatures constitute one chain of universal existence, from the beginning to the end of the world. Our own structure, and the formation of all around, above, and beneath us, in the animal, vegetable, and mineral kingdoms, proclaim the operations of an all-wise and all-powerful Being, and the constant agency of his over-ruling Providence.

It is thus we discover the Almighty Creator of all things in his works! Dark clouds rest upon his hallowed and inaccessible habitation: but the beams of glory darting from his eternal throne, shine around us on every side. We cannot with our mortal eyes behold his presence; we cannot even look steadfastly upon the orb of day, his glorious, emblem: but we can in every part of the globe trace the plain vestige of his power, wisdom and benevolence. Wherever a plant takes root and flourishes, wherever an animal appears, there is he plainly discoverable. In the depths of the Pacific Ocean, in the boundless wilds of Africa, upon the snowy summits of the Alps, and along the vast range of the stupendous Andes, he may be traced. His power and wisdom are evident in the formation of the fragrant rose, and the towering oak; in the gentle lamb, and the roaring lion; in the melodious nightingale, and the rapacious vulture. The exquisite construction of their respective parts prove the unskilfulness of men, even in their most elaborate productions, and demonstrates the admirable invention of their Creator. Compared with his works, how small, imperfect, and trifling are all the labors of art! since all he does is marked with consummate skill and excellence. He has concealed from our strictest and most persevering examination a knowledge of their essence; and as that knowledge would neither minister more abundantly to our comforts, nor increase our happiness, his benevolence is displayed in what he denies as well as in what he bestows. In his hands matter is supple and prompt to receive every impression. At his command it is formed into beings, the most strongly marked by character, and the most varied by form, from the stern lineaments and shaggy covering of the lion, to the soft plumage and delicate shape of the dove. He has impressed a never-failing symmetry upon every created being of the same species, and endowed it with the same properties: and this unchanging execution and perpetuity of his original design, proves to us the undeviating regularity of his plans. The same principles of fecundity produce each particular kinds of animals; and the same modes of preservation continue, as at the moment when by his creative voice they were first called into existence. The parents and the most distant offspring of animals are the same: preserving invariably through their successive generations the most exact resemblance of their original stock. The different kinds still continue unaltered in proportions, features, and strength, and they flourish in full youth, bloom, and vigor; and these are qualities not interrupted by the decay, nor weakened by the old age of their species. He has diversified the earth with hills and valleys, woods and plains, intersected it with rivers, lakes, and seas, affording to the eyes of man the most enchanting prospects, and the most beneficial means to supply the wants of his nature, and guard him against the inclemency of the seasons. He has clothed the surface of the earth with the refreshing verdure of grass, and the thick forests of stately trees; he has enriched it with such numerous vegetables as are more immediately conducive to the sustenance of man; and has stored its bowels with those metals, which excite his industry, and minister to his accommodation. Foreseeing the adaptation of many of his productions to the support and the comfort of human life, he has provided them in abundance; his bounty to all creatures is like the mighty ocean, flowing in perennial streams for every age:—it is open to every eye, its treasures are enjoyed wherever they are sought, but its sources are unknown and unfathomable.

Our natural desire of acquiring knowledge is ever attended with a consciousness of our ignorance; and our pride is repressed at every step we take by the limited nature of our faculties, and the tardy progress of our utmost diligence. The history of nature, indeed, as far as our imperfect researches can extend to her general economy and laws, is the history of providential goodness to all created beings: as we enlarge our acquaintance with it, the more do we understand our peculiar obligations, as creatures endued with reason, and enlightened by the revelation of the divine will. Our knowledge, therefore, is only valuable as it leads to devotion, gratitude, and obedience, which constitute the due homage of wise and dependent beings.

By looking back through the long series of past ages, we ascend to the developement of the creative power of God, as the primary cause of all existence; and we observe the proofs of omnipotence again manifested in the most tremendous manner, when at the divine command the foundations of the deep were broken up, and the guilty race of men, except righteous Noah and his family, were overwhelmed in the general deluge; of which the monuments are spread over the whole globe, to perpetuate the remembrance of sin and its punishment. By looking around us, and surveying the wide prospects of nature, we see the Almighty supreme in majesty, love, and mercy. Led by the light of science to survey the starry heavens, we behold him exercising these attributes in other worlds; and communicating the blessings of existence and providential care to other systems of creation.

Thus extending its eager views to the contemplation of objects so vast, so various, and so magnificent, our souls feel the narrowness of their faculties to comprehend the divine operations, and are overwhelmed in the contemplation of infinite power and transcendent glory; which only the bright order of celestial beings—the angels and archangels, who encompass the eternal throne of God, can adequately conceive, or duly celebrate.

The pleasures which arise from tracing this power and goodness will doubtless become incomparably more exalted and refined, when the faithful followers of the Redeemer of mankind shall be admitted to the realms of heaven and glory, and our souls disengaged from all earthly impediments, shall ascend above the stars, and resemble those angelic beings;—when the most accurate, most enlarged, and most interesting knowledge, will form a part of our eternal happiness;—when the restless mind of man shall no longer form wild and inconsistent theories to account for the formation of the globe;—*but the volume of universal nature shall be unfolded to his astonished eyes*;—when the laws, which regulate all orders of created beings, shall be fully unfolded and clearly understood, and man shall learn the true constitution of the world he now inhabits, from the time when discordant matter first obeyed the word of the Almighty, and was called into harmony and order, to the last awful period of its existence.

From Forsyth's First Lines of Chemistry.

SULPHUR.

As a mineral production, sulphur occurs in some parts of the earth, particularly in the neighborhood of volcanoes, as in Italy and Sicily. It is commonly found in a massive state; but is sometimes met with chrystallized in the form of an oblique rhombic octahedron. It exists more abundantly in combination with several metals, as silver, copper, antimony, lead, and iron. It is procured in large quantity by exposing the common iron pyrites to a red heat in close vessels.

Sulphur is a brittle solid, of a greenish yellow colour, emits a peculiar odor when rubbed, and has little taste. It is a non-conductor of electricity, and is excited negatively by friction. Its specific gravity is 1.99. At the temperature of 190° F. it begins to liquefy; at 20° F. it is in a state of perfect fusion, and if then cast into cylindrical moulds, forms the common roll sulphur of commerce. When the heat is raised to 300° F. it becomes viscid and acquires a reddish brown colour; and if poured at this temperature into water, it becomes a ductile mass, and may be used for taking the impression of seals.

Fused sulphur, on cooling, has a tendency to chrystallize. A chrystalline arrangement is perceptible in the centre of the common roll sulphur; and by good management regular chrystals may be obtained.

Sulphur has been discovered in cresses, horseradish, and several other vegetables. It is also evolved from animal substances, during their putrefaction, in combination with hydrogen. The change which silver undergoes when immersed in an egg, shows the presence of sulphuretted hydrogen.

Sulphur is very volatile. It begins to rise slowly in vapour even before it is completely fused. At 550° or 600° F. it volatilizes rapidly, and condenses again unchanged in close vessels. It is by this process that common sulphur is purified; and if the sublimation be conducted slowly, the sulphur collects in the receiver in the form of detached chrystalline grains called flowers of silver—a state, however, in which it is not quite pure; for the oxigen of the air within the apparatus combines with a portion of sulphur during the process, and forms sulphurous acid, which may be removed by washing the flower repeatedly with water.

Sulphur is insoluble in water, but unites with it under favorable circumstances, forming the white hydrate of sulphur, termed *lac sulphuris*. It dissolves readily in boiling oil of turpentine. It is also soluble in alcohol, if both substances are brought together in the form of vapour. The sulphur is precipitated from the solution by the addition of water. Like charcoal, sulphur retains a portion of hydrogen so obstinately that it cannot be wholly freed from it either by fusion or sublimation. Heated in the open air at 300° F. or a little higher, it kindles spontaneously, and burns with a faint blue light. In oxigen gas its combustion is far more vivid; the flame is much longer, and of a bluish white colour. Sulphurous acid in both cases is the product. No sulphuric acid is formed, even in oxigen gas, unless moisture be present.

Compound of Sulphur and Oxigen.—There are four compounds of sulphur and oxigen, all of which have acid properties—the compo ition of which is as follows:

	Sulphur.	*Oxigen.*	*S.*	*Ox.*
Hyposulphurous acid,	16	8	1	1
Sulphurous acid,	16	16	1	2
Sulphuric acid,	16	24	1	3
Hyposulphuric acid,	32	40	2	5

Sulphur will also combine with the alkalies—with potass, soda, and with ammonia, compounds which possess several curious and interesting properties. The alkaline and earthy sulphurets are hard substances, of a brown color, resembling the liver of animals. They absorb water from the atmosphere, and then emit a fœtid odor similar to that of putrid eggs. They decompose water, and by that process they become partially converted to alkaline or earthy sulphates.

Sulphur may be combined artificially with most of the metals, and with some earths; but many of the metallic sulphurets are found native in great abundance.

BOILING,

Or ebullition, is the agitation of a fluid body, arising from the application of heat. All fluidity is the effect of a quantity of caloric, or the matter of heat, absorbed by a body in passing from a solid to a fluid state, and boiling is the act of a body from a fluid state, to that of vapour, by a further absorption of the caloric. If the heat is applied to the bottom of the vessel, after the whole liquid has acquired a certain temperature, those particles next the bottom become elastic, and ascend as they are formed through the liquid like air-bubbles, and throw the whole into violent agitation. The liquid is then said to boil. Every liquid has a fixed point at which boiling commences, and this is called the boiling point. Thus water begins to boil, when heated to 212 degrees. After a liquid has begun to boil, it will not become hotter, however much the fire may be increased.

It was observed, however, by Dr. Hooke, that a stronger heat makes all liquids boil more rapidly, though it does not increase their temperature.

LYCEUM SEMINARIES.

APPARATUS.

ONE kind of business which the Lyceum System has ever contemplated, as furnishing the most useful and the most productive exercise for the members of Lyceum Seminaries, is the manufacture of apparatus. Such an employment would, in every respect, be in the highest degree favorable for a practical, scientific institution. The exercise itself would be highly favorable to making those engaged in it acquainted and familiar with the principles of science. The workshop would be no less a school of science, than the study and lecture-room. No one can doubt for a moment that students, who should not merely illustrate, but make the apparatus to illustrate the principles of science, must understand those principles better than it would be possible for any one to understand them from books merely.

The manufacture of scientific apparatus is not only in the highest degree favorable for intellectual improvement, but a great part of it is wholly within the strength of lads from ten to fourteen years of age. Some parts of it could be done by misses to the greatest advantage. No mechanical employment can possibly be provided so well fitted to the physical strength of children, as many parts of the work connected with the manufacture of apparatus. Such is the fact with that already made; and other articles, literally infinite, might be made and introduced into schools, lyceums, and families, to the greatest advantage.

The great amount, and the great variety of apparatus, which might be made and used, would furnish employment to a great number of individuals. And, with the improvements in machinery which may be made, apparatus can undoubtedly be made by the members of Lyceum Seminaries, so as to be afforded at one half or one third the present expense, and still furnish them with a support.

We should be glad to see a Lyceum Seminary in every county in the Union; and each one engaged in the manufacture of apparatus, to such an extent that every lyceum, school, and family in the country could be furnished with a full and constant supply. And although we have made great sacrifices of time, money and thought, in our humble efforts to forward this object, so intimately connected with the interests of education, we would cheerfully and gladly resign the whole to a Lyceum Seminary, if such an institution could be established upon an extensive and liberal plan.

TEACHERS.

Lyceum Seminaries would be eminently fitted for qualifying teachers both for schools and lyceums. The great obstacle in the way of Teachers' Seminaries, is the expense. As those who would be glad to become teachers, are generally not abundant in funds, and can have but a poor prospect for a lucrative employment, their means or inducements do not lead them to spend that time nor seek those advantages in qualifying themselves, which the great importance and dignity of the profession demand.

But as the fundamental principle of a Lyceum Seminary is *self-support*, the great obstacle mentioned will of course be entirely removed. And they will not only be provided with the means of supporting themselves by their productive industry, but their productive employment will furnish some of their most useful instruction. As the prominent object of a Lyceum Seminary is practical education, those exercises which are most practical will of course be most useful. And perhaps it would be impossible to propose a more useful employment, of a practical character, than the manufacture of apparatus. Such an employment

would fit them in the highest degree to understand its uses, and to use it for its appropriate objects, while they were in theory becoming familiar in the highest degree with the principles of science it was intended to illustrate.

Such TEACHERS' SEMINARIES must and will be established in most of the counties from Maine to Georgia, and from Florida to Michigan.

GEOLOGY.

GYPSUM.

WHILE standing at the door of a farmer, a few years since, he pointed out to us the initials of his name on a declivity sixty or eighty rods off, made by grass growing thicker and higher than the adjoining grass. It was the effects of a sprinkling of plaster of Paris. He then pointed to another field almost as white as a snow-drift, made so by the flowers of white clover, produced by sprinkling an acre of ground with a bushel of this same mineral. In another field waving with corn, every other row rose to about twice the height of the rest, occasioned by a spoonful of powdered gypsum upon each hill.

In some parts of our country, extensive districts of barren sand have been rendered highly fertile by the use of gypsum.

Various theories have been formed to explain the fact that the powder of a mineral, in quantity but a single bushel, and in weight not over a hundred pounds, should produce vegetable matter to the amount of two thousand pounds. But as none of them are satisfactory, and as *facts* respecting the mineral in question are more than sufficient to occupy the space we have for this article, we shall not take up that nor our readers' time with *opinions*.

Some perhaps may think the curiously wrought and highly polished urns, and other alabaster ornaments, a more interesting subject than fields of clover, corn and potatoes, whether produced by gypsum or any other earth. If such is their preference, they can take alabaster for their specimen of gypsum, instead of the more common varieties, used for agriculture, architecture, &c.

The alabaster so much used to ornament mantel-pieces, is, like other specimens of gypsum, composed of sulphuric acid, and lime, and is of course the sulphate of lime. It also contains a portion of water. The proportions are: sulphuric acid, 46 parts—lime, 32—and watef, 22.

In several places in Italy, in some of the islands in the Mediterranean, and in various places upon the continent, alabaster is a common rock. In this country, little if any has been found, though the more common varieties of gypsum exist in great abundance in New York, as it does in Nova Scotia, and some other places upon this continent.

Alabaster is not the only variety of gypsum which is sought for its beauty. It chrystallizes in various forms, some of which are delicate and beautiful. There is fibrous gypsum, radiated gypsum, foliated gypsum, sparry gypsum, and several other varieties, besides the common compact gypsum and alabaster.

Like the carbonate of lime mentioned in our last, the sulphate of lime now under view is found in the three great geological divisions, viz.: primitive, transition, and secondary. In the Alps, it is associated with the oldest primitive rocks, such as gneiss, mica slate, and primitive limestone. In some instances it is also found with transition rocks; but the greatest abundance, both in Europe and this country, belongs to the secondary or more recent formations, and alternates with secondary limestone. Common salt (muriate of soda) is frequently found in the neighborhood of the sulphate of lime.

Gypsum, in the language of chemistry, is a salt, being the combination of an earth, lime, and an acid sulphuric, and is hence called the sulphate of lime. Except the carbonate of lime, (common limestone,) it is more abundant than any other salt.

The uses of this salt of lime, though less important than those of the other salt, are of some importance in the useful and domestic arts. Its use in agriculture has already been referred to; and in our country, particularly, many landholders are entirely indebted to it, for the produce of their farms.

As a plaster, also, it is extensively used, especially for the finer and more ornamental work. For this use, it is first burnt, by which the water of chrystallization is driven off, and a part or the whole of the acid. After being thus burned, water is mixed with it, when, on drying, it becomes hard.

Of alabaster much statuary work is made, as is shown by mantel-pieces all over the country. For such work, its softness, semi-transparency, and the fine polish it receives, fit it in a peculiar manner.

CO-OPERATION OF SCHOOLS.

WE are glad to acknowledge a favor from a YOUNG LADIES' SEMINARY in this city, both in behalf of ourselves and of our readers. The description given below of a visit to a type-foundry, is an interesting account of an interesting subject, coming from the best source. We are sure it will be read with interest, not only by the members of the numerous schools where the Lyceum is used, both for reading exercises and study, but by all our readers who are interested in the diffusion of knowledge or the progress of the arts.

We hope, and believe, that the time is not distant, when Schools of all descriptions throughout our country will co-operate in the great and dignified object of DOING GOOD TO EACH OTHER, and, of course, to the country and the world.

VISIT TO A STEREOTYPE FOUNDRY.

A few days since, a Teacher in this city was invited to visit a Stereotype Foundry, by a gentleman connected with the establishment. Two young ladies from among his pupils were nominated to accompany him, on condition that they should, on their return, present a written description of their visit. The following account was in consequence furnished.

Agreeably to the nomination of the young ladies of this school, we visited, on Thursday last, the STEREOTYPE FOUNDRY, with our Teacher. The building is situated in Water-street, No. 18. On entering, we were politely received by Mr. B., who conducted us first into a room appropriated to the setting of types and the correction of proof-sheets. The first thing which attracted our attention was two females—one of whom was reading the perfect copy of a work then in press to the other, who held a proof-sheet of the same work in her hand, and corrected all imperfections. The manner in which she read, appeared very amusing to us—for instance, when she came to a comma, she abbreviated it by saying com.; for semicolon, sem.; for a period, point, &c. At the farther end of the room, other females were setting types, and in the centre of the same apartment were young men locking them up; both of which processes Mr. A. has formerly described. We then descended into a small dark room, where every thing was covered with a white dust, which we found, on examination, to be plaister of Paris. This was called the *moulding-room*. Here the pages of types were brought and enclosed in a frame, and then covered with this plaister, mixed with water to the consistence of cream.—This was suffered to remain till the paste became hardened, when the page of types was taken from the under side, and we found it had left a perfect impression on the mould.

Mr. B. then conducted us to a small and very dirty room, where he said the moulds were brought from the moulding-room. We saw very large pieces of type mould lying about the room on the floor. In one corner there was a large kettle, which was half-filled with type metal, melted by a fire underneath. Over the kettle there was a crane, to which was attached by a chain a basin, a foot and an half in length and six inches in depth. This basin descended into the kettle, and hung so low as to be entirely covered by the type metal. A man who was standing near, and who had the charge of this part of the business, soon took it off, and placed it in a reservoir of water which was in the middle of the room, that it might cool. While this was cooling, he took another basin, and filling the bottom of it with mould, with the printed side downwards, he placed an iron cover upon it, which had holes perforated in the corners of it, and sunk it in the metal, in the same way with the other. After having done this, he took the basin first spoken of from the water, and placed it on a log which was in another part of the room. He then took off the cover, and we saw a perfect impression of the letters of the mould made upon the type metal. These are called *stereotype plates*, which are now conveyed to another room, where they are all made of an equal thickness by shaving. After shaving, the plates belonging to one work are placed in a drawer, and the name of the work written upon the outside of the drawer. These plates, after being blocked, are ready for use, and when they have been used, are again melted and prepared with other moulds for some other book.

Mr. B. then politely gave each of us a stereotype plate, and some of the type shavings, as memorials of our visit—and we then took our leave, pleased with all we had seen.

SCHOOL AGENT SOCIETY.

EDUCATION Agents, co-operating with Lyceums which are and may be organized, can evidently with the greatest ease and in a short time, extend their influence over the whole habitable globe.

NEW ENGLAND.

So much progress is already made on this subject in New England and New-York, whose institutions and state of society are almost entirely the same, that the completion of the plan is in full prospect. A slight effort on the part of a few individuals in each of the twelve hundred towns in New England, would be sufficient to procure a Lyceum building upon the plan given in the fourth and ninth numbers of our own paper, and in several other papers in Boston, and which is to be given in the papers in other cities and towns, for which arrangements are already made. We wish to present this subject again and again to our readers, because we consider it one of the corner-stones of the whole fabric, towards which we wish to direct our humble but persevering efforts. We are sure it is not possible to create or conceive of more valuable property, either to individuals or our Republic, than buildings with accommodations for the intellectual and social resort of both sexes, and all classes and ages of society. We are also sure that no object could be more readily accomplished throughout our country, if a few spirited individuals in each town and village should unite in effecting it.

While measures are in progress to procure Village Lyceums, as commodious places of resort and instruction, the School Agent Society will be upon the alert to find and qualify Teachers to occupy them. And entering into this system of operation and co-operation, it is hoped, that in New England at least, an important step in the great work of MUTUAL AND SELF-EDUCATION may be taken early next season.—We hope that every town in New England may, during the next summer, have the advantage of a Circuit School.

WESTERN VALLEY.

If a system of Circuit Teaching is important and easy of accomplishment in New-England, it is indispensable in newly-settled countries. To establish and sustain daily schools throughout the infant settlements in our country, is impossible; and those that are going up can generally be little more than an apology for schools, and an apology more to be regretted in many cases, than no pretence.

But to establish weekly or semi-monthly schools, under a system of itineracy, so as to give to every child, if not a whole loaf, a small crumb, is certainly practicable and easy, through the whole of the Western Valley, and the southern declivity of our country.

Such a system is not only practicable in the Great West and South, but it must possess some advantage over a system of daily instruction, if that could be established and sustained. More can attend, interest can be better and longer sustained, more of the school can be carried into the family, an intellectual taste can be more generally and successfully cultivated, instruction can be rendered more practical, and of course more useful, to farmers, mechanics, and other industrious classes; and the whole mass of the community, both sexes, all classes and ages, can with far greater ease be led to participate in it.

INDIANS.

Itinerant teachers travelling among the Indians, could give to them in a short time the advantages of intellectual improvement, and the arts of civilization. Can any doubt, that an intelligent person, who understood the language of an Indian tribe, could entertain and instruct a collection of them, for an hour, by some illustrations with a simple globe? They already understand the geography of their own countries far better than most of the children of New-England, whose attention at school is so much carried away from themselves and the things around them, to attend to objects in some distant and unknown regions of the universe. Their minds could in an instant be brought into a most delightful and successful action, by presenting to them something which should represent the earth they inhabit, with its continents, oceans, islands, lakes, mountains, rivers, &c. A child of eight or ten years old, in any Indian town, could comprehend as readily as children of the same age in New-England, all the elementary principles of geography, which could be illustrated in an hour or a day by a globe.

By a similar process they might be initiated into the first principles of Arithmetic, Geometry, and most other branches taught in our schools.

The implements of agriculture and of the useful arts might also be made known to them by models, or by the instruments themselves. The saw, chisel, plain, plow, hoe, scythe, rake, &c. might all be used by itinerant teachers, as instruments both of instruction and entertainment to native savages, or to any other natives on our globe.

AFRICA.

It has been stated that more than a hundred princes or the sons of the kings of different tribes in the interior of Africa, have at different times been drawn to Liberia, for the advantages of instruction. If such is the fact, how easy it would be for an agent in that colony, who understands the natural and direct process of acting upon mind and heart, to exert, through such representatives, an influence upon the whole of that continent? It cannot be doubted for a moment that the School Agent Society, acting through the medium of the colony at Liberia, might, in the course of a few years, plant trees of knowledge in the various parts of Africa, which would scatter their fruit to its utmost limits.

Each of these fields of labor and of benevolence—New-England, the Western Valley, our native Indians, or abused Africa—does of itself present an object of sufficient magnitude and interest, to secure to the society which is aiming to forward it, not merely the good wishes, but the contributions, the *money*, of those who are able to give, and who are disposed to cast in a mite to relieve suffering humanity.

Several agents have already been engaged to act in behalf of the society, who have done much to promote its objects without calling upon it for pecuniary assistance. The society have also secured and wish to support, for one year, an agent, who shall first travel into New-England, to look up fellow-laborers, and then with them to go to the West, or to other parts of the country, where he and they may labor in such a way as to strengthen each others hands, and to secure the confidence and the patronage of the friends of education in all sections of our Union.

ECONOMY AND COMFORT.

THOMAS G. FESSENDEN, like the philosophers and philanthropists Rumford and Franklin, who have gone before him, first investigates the laws of nature, and then applies those laws to increase the stock of human comforts. Many instances of this kind might be mentioned, in relation to Mr. Fessenden; but we wish at this time to call the attention of our readers to a *steam stove* invented by him. Knowing the great capacity of water for heat—that it was capable of accumulating a larger quantity of heat than any other substance within given temperatures; and that, when heated, water gave it off gradually to surrounding objects, Mr. F. proposed an instrument by which this principle of water might be used for domestic economy and domestic comfort.

As the principle on which this improvement is founded would suggest, it answers two purposes; it retains more of the heat created by fuel than any other stove, and it dispenses it more uniformly and for a longer time when accumulated. It is a reservoir for heat; and of such a character, that the heat can be laid up in it and called for as needed. A third purpose might have been mentioned as answered by this instrument of economy and comfort; that is, producing a softer and pleasanter heat, less dry and uncomfortable than that produced by most stoves.

The construction of this stove is perfectly simple, and will be readily understood by the cut, though that represents but one among several forms in which it is constructed. It consists of a stove much like a common one, except smaller for the same room, with a boiler, and several cylinders above it for diffusing the great quantity of heat accumulated by the water, which it does in large quantities, according to the fire, and for some length of time after the fire is entirely extinguished.

As provisions for heat in our climate are among the most expensive to be made for families, and as they are more intimately connected with our comfort than almost any other, it only needs to be known that heating apparatus, of superior advantages, are to be had, to have those who understand the 'art of being comfortable,' at the least expense, avail themselves of it without delay; especially at this season of the year, when artificial heat must be produced in some way, and when the ordinary ways are all expensive and imperfect.

COUNTY LYCEUMS.

THE Rutland (Vt.) County Lyceum have already done much for schools within their district, and have set an example worthy of being followed by every county in the Union. Since their organization, two years since, they have had a semi-annual meeting, much to the interest of those who attended, and to the improvement of all the schools in which they were concerned.

They are now about commencing a course of instruction of some length, particularly designed for Teachers. This is pursuing a legitimate object of County Lyceums, in a legitimate way. If, in addition to this, they would employ an agent to visit all the towns in their county, who should become acquainted with all the teachers and all the schools in each, they would take another important step, and set another good example.

If the Rutland County Lyceum would take measures to procure, and would actually procure maps of all their towns, embracing geography, geology, agriculture, and statistics, they would confer a favor upon themselves and their friends, which they could not easily calculate, and set an example to other counties, which must and would be followed.

To realize either of these objects most completely, Lyceum buildings in their several towns would be an important measure, and could not fail to secure them all, and many others which would enlighten and bless posterity.

Another object still more important than either of those mentioned, might with the greatest ease be effected by a County Lyceum, viz.: the establishment and patronage of a LYCEUM SEMINARY, or a Self-Supporting School.

On this subject we most earnestly wish, that the intelligent and spirited friends of education in Rutland County would set an example for the world. That they might do; for a self-supporting school, in the true sense of the word, contains a principle, which, if extended as it might be, would restore our fallen race from their degraded state, and render them worthy of their nature and their God.

THE Illinois State Lyceum, which was organized less than a year since, is in a prosperous condition. Lyceums in Missouri, Kentucky, Tennesse, and Mississippi, are also increasingin number and interest.

RAIL-ROADS.

LIVERPOOL AND MANCHESTER.

The Mechanic's Magazine gives a copy of the statement of the balance sheet of the Liverpool and Manchester Rail-way from the 1st of July to the 31st of December, 1831, showing that the undertaking is going on with increasing prosperity. To this statement it adds the following abstract from the evidence on the advantages of Rail-Roads.

Before the establishment of the Liverpool and Manchester Rail-way, there were twenty-two regular, and about seven occasional extra coaches between those places, which if full, could carry only six hundred and eighty-eight persons per day. The Rail-way from its commencement carried seven hundred thousand persons, in eighteen months, being an average of one thousand and seventy persons per day. It has not been stopped for a single day. There has occurred but one fatal accident on it in eighteen months. The fare by coach was 10*s.* inside, and 5*s.* outside. By rail-way it is 5*s.* inside, and 3*s.* 6*d.* outside. The time occupied in making the journey by coach was four hours. By rail-way it is one and three quarters. All the coaches but one have ceased running, and that for conveyance of parcels. The mails all travel by the rail-way, at a saving to government of two-thirds of the expense. The rail-way coaches are more commodious than others. The travelling is cheaper, safer and easier. A great deal of traffic, which used to go by other roads, comes now by rail-way; both time and money are saved, though the length of the journey may be often increased. The proportion of passengers carried by rail-way over those carried by coach, has been as twenty-two to ten in winter, and seventeen or nineteen to ten in summer. A regiment of soldiers has been carried by the rail-way from Manchester to Liverpool in two hours. Gentlemen's carriages are conveyed on trucks by the rail-way. The locomotives travel in safety after dark. The rate of carriage of goods is 10*s.* per ton—by canal it used to be 15*s.* per ton. The time occupied in the journey by rail-way is two hours—by canal it is twenty hours. The canals have reduced their rates thirty per cent. Goods are delivered in Manchester the same day they are received at Liverpool—by canal they were never delivered before the third day. By rail-way, goods, such as wine and spirits, are not subject to the pilferage which existed on the canals. The saving to manufacturers, in the neighborhood of Manchester, in the carriage of cotton alone, is £20,000 per annum. Some houses of business save £500 a year in carriage. Persons now go from Manchester to Liverpool and back in the same day with great ease. Formerly they were generally obliged to be absent the greater part of two days. More persons now travel on their own business.

The rail-way is assessed to the parochial rates in all the parishes through which it passes; though only thirty-one miles, it pays between £3000 and £4000 per annum in parochial rates. Coal-pits have been sunk, and manufactories established on the line, giving great employment to the poor: manufactories also erected on the line, giving increased employment, and thus reducing the number of claimants for parochial relief. The rail-way pays one-fifth of the poor rates in the parishes through which it passes; fresh coal mines sunk, owing to the facilities of carriage; and prices reduced. It is found advantageous for the carriage of milk and garden produce. Arrangements are about to be made for milk to be carried fifteen miles at one shilling for ten gallons, (i. e. less than one farthing per quart.) Mr. Babbage observes, in his book on the Economy of Manufactures, "One point of view, in which rapid modes of conveyance increase the power of a country, deserves attention. On the Manchester rail-road, for example, above half a million of persons travel annually; and supposing each person to save only one hour in the time of transit between Manchester and Liverpool, a saving of five hundred thousand hours, or fifty thousand working days, of ten hours each, is effected. Now this is equivalent to an addition to the actual power of the country of one hundred and sixty-seven men, without increasing the quantity of food consumed, and it should also be remarked that the time of the class of men thus supplied, is far more valuable than that of mere laborers.'

Note. The experiments in this country have been sufficiently numerous and successful, to render the general introduction of them certain. Those already in operation have cost less and produced more than was anticipated by their friends.—Ed.

THE ARTS.

From Good's Gallery of Nature and Art.

ENAMELLING.

The delicate and beautiful art of enamelling consists in the application of a smooth coating of vitrified matter (transparent or opaque, and with or without colour, figures, and other ornaments) to a bright polished metallic substance. It is, therefore, a kind of varnish made of glass, and melted upon the substance to which it is applied, and affording a fine uniform ground for an infinite variety of ornaments, which are also fixed on by heat.

The general principles on which enamelling is founded, are on the whole very simple, but, perhaps, there is none of all the chemico-mechanical arts which requires, for the finer parts, a greater degree of practical skill and dexterity, and of patient and accurate attention to minute processes.

The concealment observed by those who profess this art, is proportioned to the difficulty of acquiring it; the general chemist must, therefore, content himself with the general principles of enamelling, and the detail of those particulars that are commonly known.

Though the term enamelling is usually confined to the ornamental glazing of metallic surfaces, it strictly applies to the glazing of pottery or porcelain, the difference being only that in the latter the surface is of baked clay. With regard to the composition of coloured enamels, (which are all tinged by different metallic oxyds,) a very general account of the substance used will suffice in this place, the rest of the subject having been treated of in the article of coloured glass. The enamelling on metals, therefore, will only be noticed in this place. The only metals that are enamelled are gold and copper; and with the latter the opaque enamel are only used. Where the enamel is transparent and coloured, the metal chosen should be of that kind, as not only to have its surface unalterable when fully red-hot, but also to be in no degree chemically altered by the close contact of melted glass, containing an abundance of some kind of metallic oxyd. This is the chief reason why coloured enamelling on silver is impracticable, though the brilliance of its surface is not impaired by mere heat, for if (for example) an enamel made yellow with oxyd of lead, or antimony, is laid on the surface of bright silver and kept melted on it for a certain time, the silver and the enamel act on each other so powerfully, that at the colour soon changes from a yellow to an orange, and lastly to a dirty olive. Copper is equally altered by the coloured enamels, so that gold is the only metal which can bear the long contact of the coloured glasses at a full red heat, without being altered by them.

The simplest kind of enamel is that fine, white opaque glass, which is applied to the dial plate of watches. The process of laying it on (which may serve as a general example of the art) is the following.

A piece of thin copper sheet, hammered of the requisite convexity, is first accurately cut out, a hole drilled in the middle for the axis of the hands, and both the surfaces made perfectly bright with a scratch brush.

A small rim is then made round the circumference, with a thin brass band rising a little above the level, and a similar rim round the margin of the central hole. The use of these is to confine the enamel when in fusion, and keep the edges of the plate quite neat and even. The substance of the enamel is a fine white opaque glass, the material of which will be presently mentioned. This is bought in lump by the enamellers, and is first broken down with a hammer, then ground to a sufficiently fine powder, with some water, in an agate mortar; the superfluous water being then poured off, the pulverised enamel remains of about the consistence of wetted sand, and is spread very evenly over the surface of the copper-plate by many dexterous manipulations. On most enamellings, and especially on this, it is necessary also to counter-enamel the under concave surface of the copper-plate, to prevent its being drawn out of its true shape, by the unequal shrinking of the metal and enamel on cooling. For this kind of work, the counter enamel is only about half the thickness on the concave as on the convex side. For flat plates, the thickness is the same on both sides.

The plate covered with the moist enamel powder, is warmed and thoroughly dried, then gently set upon a thin earthen ring, that supports it only by touching the outer rim, and put gradually into the red hot muffle of the enameller's furnace. This furnace is constructed somewhat like the assay furnace, but the upper part alone of the muffle is much heated, and some peculiarities are observed in the construction, to enable the artist to govern the fire more accurately.

The precise degree of fire to be given here, as in all enamelling, is that at which the particles of the enamel run together into an uniform pasty consistence, and extend themselves evenly over the surface, shewing a fine polished face, carefully avoiding on the other hand so great a heat as would endanger the melting of the thin metallic plate. When the enamel is thus seen to sweat down, as it were, to an uniform glossy glazing, the piece is gradually withdrawn and cooled, otherwise it would fly by the action of the cold air.

A second coating of enamel is then laid on and fired as before, but this time the finest powder of enamel is taken, or that which remains suspended in the washings. It is then ready to receive the figures and division marks, which are made of black enamel, ground in an agate mortar, with much labour, to a most impalpable powder, worked up on a pallet with oil of lavender, or spike, and laid on with an extremely fine hair brush. The plate is then stoved, to evaporate the essential oil, and the figure burnt in as before. The polishing with tripoli, and minuter parts of the process, need not be here mentioned.

If the enamel be chipped off a dial plate, (which may be done with the utmost ease, by bending it backwards and forwards, as the adhesion between the metal and glazing is very slight) the part immediately in contact with the copper will be found deeply and nearly uniformly browned, which shews how unfit copper alone would be for the transparent enamels.

The regulation of the fire appears to be the most difficult of all the parts of this nice process, particularly in the fine enamelling of gold for ornamental purposes, of designs, miniatures and the like, where three, four, or sometimes five separate firings are required. If the heat is too low, the enamel does not spread and vitrify as it ought; if too high, it may be enough to melt the metal itself, whose fusing point is but a small step above the enamel, or else (what is an equal mortification to the artist) the delicate figures, laid on with so much care and judgment, melt down in a moment, and the piece exhibits only a confused assemblage of lines, and fragments of designs.

The most beautiful and costly colour known in enamelling, is an exquisitely fine rich red, with a purplish tinge, given by the salts and oxyds of gold, especially the purple precipitate, formed by tin in one form or other, and nitro muriat of gold. This beautiful colour requires much skill in the artist to be fully brought out. It is said, that when most perfect, it should come from the fire quite colourless, and afterwards receive its colour by the flame of a candle. Gold colours will not bear a violent fire.

Other and common reds are given by the oxyd of iron, but this requires the mixture of alumine or some other substance refractory in the fire, otherwise at a full red heat the colour will degenerate into black.

Yellow is given either by the oxyd of silver alone, or by the oxyds of lead and antimony, with similar mixtures to those required for iron. The silver is as tender a colour as gold, and readily injured or lost in a high heat.

Green is given by the oxyd of copper, or it may also be procured by a mixture of blue and yellow colours.

Blue is given by cobalt; and this seems of all enamel colours the most certain and easily manageable.

Black is produced by a mixture of cobalt and manganese.

The reader may conceive how much the difficulties of this nice art are increased, when the object is not merely to lay an uniform coloured glazing on a metallic surface, but also to paint that surface with figures and other designs, that require extreme delicacy of outline, accuracy of shading, and selection of colouring. The enamel painter has to work, not with actual colours, but with mixtures, which he only knows from experience will produce certain colours after the delicate operation of the fire; and to the common skill of the painter, in the arrangement of his pallet and choice of his colours, the enameller has to add an infinite quantity of practical knowledge of the chemical operation of one metallic oxyd on another, the fusibility of his materials, and the utmost degree of heat at which they will retain not only the accuracy of the figures which he has given, but the precise shade of colour which he intends to lay on.

Painting in enamel requires a succession of firings; first of the ground which is to receive the design, and which itself requires two firings, and then of the different parts of the design itself. The ground is laid on in the same general way as the common watch face enamelling already described. The colours are the different metallic oxyds, melted with some vitrescent mixture, and ground to extreme fineness. These are worked up with an essential oil (that of spike is preferred, and next to it oil of lavender) to the proper consistence of oil colours, and are laid on with a very fine hair brush. The essential oil should be very pure, and the use of this, rather than any fixed oil, is probably that the whole may evaporate completely in a moderate heat, and leave no carbonaceous matter in contact with the colour when red hot, which might affect its degree of oxidation, and thence the shade of colour which it is intended to produce. As the colour of some vitrified metallic oxyds (such as that of gold) will stand only at a very moderate heat, whilst others will bear, and even require, a higher temperature to be properly fixed, it forms a great part of the technical skill of the artist to supply the different colours in proper order; fixing first those shades which are produced by the colours that will endure the highest heat, and finishing with those that demand the least heat. The outline of the design is first traced on the enamel, ground and burnt in; after which, the parts are filled up gradually with repeated burnings, to the last and finest touches of the tenderest enamel.

Transparent enamels are scarcely ever laid upon any other metal than gold, on account of the discolouration produced by other metals, as already explained. If, however, copper is the metal used, it is first covered with a thin enamel coating, over which gold leaf is laid and burnt in, so that, in fact, it is still this metal that is the basis of the ornamental enamel. With regard to the vast number of important minutæ in the selection and order of applying the colours, the management of the fire, &c. almost the whole of what is known on this subject is confined to the practical artist. Nor could this knowledge, if it were obtained, interest the general reader.

GROTTO DEL CANO.

The Grotto del Cano, situated about two miles from Naples, is celebrated for the noxious nature of the air contained in it, which is in fact carbonic acid gas. As this gas, from its weight, must always lie along the bottom of the cavern, small animals on entering must breathe it; whereas a man may traverse it in safety, as his head is considerably above the pestilential vapour. The height to which the gas rises, may be seen from observing the colour of the sides of the cavern.

QUESTIONS on LYCEUM No. 12.

When and where was Pythagoras born?

What was the employment of his father?

In what way did he spend a considerable portion of the early part of his life?

How long a time did he spend in Egypt?

What other places besides Egypt did he visit in pursuit of knowledge?

What three different modes of teaching did he learn and practice?

Was Pythagoras of a pacific or a warlike character?

Did he create or appease sedition?

Did he entertain disrespect or reverence for the institution of marriage?

Where is the temple of Elephanta, and from what did it receive its name?

How is its front supported?

What is the center of the temple?

How thin can gold be beaten?

Can gold be made thinner by any other process than beating?

How small can a wire be made of platinum?

How much water can be coloured by a grain of sulphate of copper, [blue vitriol?]

What other instances are known of the great divisibility of matter?

Which part of the physical system of man, under the guidance of reason, is most useful to him?

How many joints and bones are there in the hand?

What kind of joint is the knee?

Is the knee a weak or strong joint, and how is it protected?

How many bones are there in the leg below the knee? Also in the arm below the elbow?

What three kingdoms are embraced in the subject of Natural History?

What two general divisions are made of Natural History?

Which kingdom, that is made the subject of Natural History, consists of unorganized bodies, the animal, vegetable, or mineral?

What six classes did Linnæus make of the animal kingdom?

What scientific and practical mechanic in Boston furnishes apparatus of a good quality?

Are marbles composed of lime or silex?

What acid is combined with lime to form the common limestone?

What substance is driven off from the lime in the process of burning?

To which of the three divisions of rocks do limestones belong, primitive, transition, or secondary?

Where is the most extensive range of limestone in New England?

In what town in Rhode Island is there a deposit of limestone?

Is the limestone in Bolton, Mass. older or more recent, than the adjoining gneiss?

In what place in Massachusetts is lime found resembling the Italian statuary marble?

Where, in the Northern States, is a range of transition limestone?

Which kind of limestone contains organic remains, primitive, transition, or secondary?

Among what nations has the institution of marriage been recognized, civilized or savage, or both?

What nations have encouraged marriage by direct legal provisions?

Is gelatin an animal or vegetable substance?

How many ingredients compose gelatine, and what are their names and proportions?

How many ingredients compose sugar, starch and alcohol, and what are their names and proportions?

What was the mean temperature of the atmosphere at Savannah, during the month of September last, and how much below that of the month preceding?

What is the prominent feature of the Lyceum system, *individual effort*, or getting up annual or occasional lectures?

On what subjects can schools, in different parts of the Union co-operate?

What have been some of the results of the example set by the farmers and mechanics in Millbury, in organizing their Lyceum?

What is the use of mordants in the art of calico-printing?

What are some of the mordants used? Also the other substances in calico-printing?

Are different colours applied to calicos by the same or by different processes?

What substances are used in silvering looking-glasses?

What two general divisions are made of the motions of animals?

Has any explanation ever been given how mind can act upon matter?

Is the motion of the blood in the veins and arteries voluntary or involuntary?

Is the act of walking a voluntary or involuntary motion?

What is the substance which constitutes the natural magnet?

Which are most powerful, natural or artificial magnets?

From what animal is ivory procured?

When ivory is burned, what paint or colouring matter is formed from it?